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CYBERWAR AND INFORMATION WARFARE: A REVOLUTION IN MILITARY AFFAIRS OR MUCH ADO ABOUT NOT TOO MUCH?

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CYBERWAR AND INFORMATION WARFARE: A REVOLUTION IN MILITARY AFFAIRS OR MUCH ADO ABOUT NOT TOO MUCH?

Introduction

Throughout recorded history there have been a number of major changes in the way wars are fought that have been related in some degree to changes in technology Looking back on these changes, and at the changes that are being caused by the rapid advances in today's technology, many people assert that we are in the midst of a revolution in military affairs (RMA) The Department of Defense's Office of Net Assessment defines an RMA as "a major change in the nature of warfare brought about by the innovative application of technologies which, combined with dramatic changes in military doctrine, and operational concepts, fundamentally alters the character and conduct of operations "[1] A study of history reveals, however, that technology does not, in and of itself, change the way armies conduct the business of waging war For example, while the armies of the French Revolution coincided with the beginnings of the Industrial Revolution, it was the incorporation of the people into the war effort through the *levée en masse* which had the most profound impact on how war was waged after 1815[2] And furthermore, despite the profound impact of the *levée en masse,* it was not revolutionary in a sense of having sprung full blown at that precise period in history[3]

Since the dawn of time, when the tribal army emerged from the armed tribe, warfare has been characterized as follows Military organizations are formed for either defensive or offensive purposes, to protect the tribe or nation or to defeat an enemy who had something the tribe or nation coveted Consequently, they are by nature conservative Sudden alterations in the way armies conduct operations, introduced without testing and

Low-tech adversaries can sometimes give us a run for our money.

proof of their efficacy, can render an army incapable of fulfilling its basic purpose When new battlefield technology is introduced, militaries typically approach it warily, retaining much of the old way of doing things to ensure a capability of meeting known or expected threats, or until the old way is demonstrated to be no longer capable of coping with threats This is not to argue against adopting new technologies, for armies must still prepare to cope with peer adversaries As long as we live in a world where the fruits of technology are not evenly distributed, however, the modern army must keep a foot in both camps - retaining the ability to deal with the known threat of technologically less advanced foes while preparing for the unknown. It is evolution then, rather than revolution, which sets the upper limit of change, and the failure to find the proper balance between the known and the unknown can cause wasted resources and lost opportunities

What makes the current age appear revolutionary is the dizzying speed at which new technologies are introduced With the end of the Cold War, future threats are ill-defined or unknown. Under such conditions it is prudent to make haste slowly This is not to argue that change is not necessary We must continually change to keep pace with a changing world, while at the same time, retaining the capability to meet more traditional threats "There is a tendency to want to reduce complex institutional behavior to simple one-dimensional characterizations. 'revolutionary technology holds the answer to the future of war,' or 'without any external threats there is no need for advanced strategic thinking '" [4] The new technologies, those existing and those yet unknown, will have to be integrated into our force structure, tactics and security planning process But, history argues that change, when it comes, will be in response to a host of factors and, in the final

Balancing old and new technology - no easy task.

analysis, technology might prove to be one of the least significant. While we cannot afford to ignore new technologies, because of the possibility of a technological leap by a potential adversary, we also cannot afford to assume that possession of advanced technology alone will ensure that we will prevail over less advanced adversaries What is needed is a balanced approach - maintenance of sufficient existing capability while, at the same time, preparing for the unknown

From Greece to Macedon

In the 5th Century BC the Greeks introduced mobility and an increased use of cavalry and missile weapons which for a time prevailed over the mass formations commonly in use at the time In the end, the decline of Greece as a power was due to civil decay and incessant civil wars [5]

Philip of Macedon, a prince from a petty and semi-barbaric northern kingdom, had been a prisoner in Thebes and in 371 BC observed the Theban victory at the battle of Leuctra Philip was impressed by the victory, but at the same time saw the shortcomings of the Theban tactics When he took over the throne, he undertook to build what became the world's first truly national standing army [6] The army that Philip built and bequeathed to his son Alexander, though it did possess some technological innovations, also creatively employed existing technology that was centuries old

Recognizing that the phalanx, though excellent for defense, was inadequate for offensive operations, Philip introduced the *sarissa*, a spear that was 21 feet long as compared to the Greek pike which was never longer than about 14 feet At the same time, he extended the depth of the phalanx from eight to sixteen ranks "On level ground this

mobile human fortress was invincible when it bore down with locked shields and bristling points "[7] To protect the vulnerable flanks and rear, Philip developed supporting light infantry which included archers and javelins and added mobility to the force In Philip's time, effective engines of war had been known for centuries,[8] but their use had been restricted to siegecraft. In a truly innovative move, Philip added an artillery arm to his force In addition, he originated the idea of carrying only the essential parts of the engines, relying on local trees to supply the timbers which made up the heaviest parts With some changes in name, both the ballista and the catapult lasted until the late Middle Ages before any significant changes in artillery were introduced

Twenty-two years after he left Thebes as a hostage, Philip appeared at the gates of the city with his new army to challenge the supremacy of Greece With a force of 40,000 he defeated a numerically superior force This same army, under Philip's son Alexander, crossed the Hellespont four years later to challenge the known world

The Dark Ages

From rise to fall the Roman Empire's only significant technological contributions to warfare were the *pilum* and the *gladius*.[9] The introduction of the legion, a more tactically flexible formation than the phalanx, was probably more militarily significant. After Rome's demise, barbarian tribes, the Goths and Vandals, held sway militarily for a few generations, but followed the empire into obscurity The Visigoths ruled Spain until the eighth century, but were regularly beaten in encounters with the Franks and were an easy conquest for the Saracens

"All three peoples disappeared from history, and with them vanished the last cherished traces of Roman military skill in the West Another cycle had been completed, and the methods of warfare reverted to their crudest beginnings "[10]

In the sixth century Frankish war bands were merging into a kingdom of sorts The sons of Clovis had developed into able war leaders and his domain extended to include half of Germany, most of France, and the territory that is now Switzerland and the Low Countries. At the beginning of the seventh century this domain had become the foremost power in Europe and was the only force capable of stopping the Moorish incursion which had reached France by 732 The defeat of the Moors, however, relied entirely on bulk and, it was not until the accession of Charles the Great (Charlemagne) that any effort was made to improve the quality of the forces "Charlemagne retained the principle of universal service but formed his subjects into small groups, each being required to send one well-armed man instead of several wretchedly equipped peasants "[11] This formed the basis of the feudal system which became the foundation of European armies The technological advancement of this period was the invention of the stirrup in the early 800s which, by providing a stable mounted platform, enabled the introduction of cavalry shock tactics which persisted with only minor modifications through the 19th century The first significant use of cavalry against infantry, however, was not until 1066 at the battle of Hastings when Norman forces defeated the army of King Harold

With Cross and Crossbow

The next significant technological development in warfare occurred in the eleventh century because of the *arbalest*, or crossbow This was, in fact, a *ballista* on a small

scale, but it fired a small bolt which could pierce the best Eastern armor, and could be fired from a prone position The bolts were also cheaper and less bulky than arrows, though it was slower because of the requirement to wind the winch after each shot. The crossbow was mentioned in the battle of Hastings in 1066, but it was merely a novelty until the Crusades Combined with the shock tactics of the Christian army, the penetrating missile attack of the crossbow was key to the defeat of Eastern forces at Jerusalem, Arsuf and Jaffa

In the thirteenth century the English dominated the military scene through employment of the longbow The national weapon of England, the six-foot longbow had greater accuracy, penetration and range than the crossbow or the shorter bow, and was able to penetrate the armor of French knights In addition, the longbow could be fired faster than the crossbow "Still, for all of the superiority of their new weapon, the English owed far more to tactics, organization and national spirit "[12] While the lowborn men of Europe remained serfs, the Magna Charta had unfettered the English and for the first time in the Middle Ages the men in the ranks were serving as paid professional soldiers rather than levy on the part of their feudal masters

Gunpowder

The use of explosive compounds to propel missiles had a profound effect on the conduct of war, in that it had increased lethality and allowed kills from greater distances Yet, for all of this impact, gunpowder, like other inventions mentioned, did not alter military operations for a long period after it was invented The Chinese had a form of gunpowder as early as the tenth century, which was used primarily in rituals and

celebrations The first known mention of gunpowder in Europe was by the English friar Roger Bacon in 1249, as a compound of saltpeter, charcoal and sulfur The appearance of the first 'firearms' is thought to be in the first quarter of the fourteenth century By the middle of the century, however, these weapons had become so common as to be the principal inventory of armories.[13]

The first French weapons of gunpowder were called *pots de fer* and the Italians called their first gunpowder weapons *vasi*, calling to mind the ancient fire pots The leap from the single shot *pots de fer* to the idea of repeating weapons was amazingly short In 1339, there were reports of a weapon called the *ribaudequin*, which consisted of tubes clamped together so that they could all be fired at a single sweep of the linstock In 1387, in Verona, three huge pieces were constructed, each made up of 144 tubes permitting twelve discharges of twelve balls Shortly afterwards, the idea of multiple fire went into discard

The most extensive development of gunpowder weapons in the early centuries was in field pieces, with much slower development of infantry weapons Though the word "shell" did not come into vogue until the late eighteenth century, nearly all of the modern types of artillery ammunition had their forerunners as early as the fifteenth century

The most significant impact of gunpowder early on was economic Though the range and penetrating power of the new weapons forced efforts to develop better protective armor, the development almost overnight of a munitions industry to satisfy the demand for the new weapons was even more significant [14] With the development of such industries, and the establishment of the Middle Ages' first standing army by Charlemagne,

the calculus of the battlefield began to change to favor the nation with the material advantage of not just numbers, but the ability to manufacture the implements of war

The development of gunpowder weapons also had a significant impact (tactical and economic) on fortifications Prior to the arrival of cannons and other gunpowder bombard weapons, "every province had its castles and minor strongholds which existed by preying upon commerce "[15] These fortified positions inhibited commercial contacts between regions but with the new developments their days were numbered The new weapons were at first less effective against walled towns than minor castles and fortifications, but further improvements enabled breaching of even the most formidable walls With the fall of Constantinople to the Turks in 1453, the science of fortification underwent dramatic changes The ability to concentrate devastating fires on one spot made medieval walls and towers, no matter how strongly fortified, vulnerable to an attacker Military engineers began to dig in for protection rather than build upward and create targets for an enemy's siege weapons

What did not change for over three centuries after the invention of gunpowder was generalship on the field. Though possessing of greater range, the slow rate of fire of the early weapons did not force, or even permit, a change in basic tactics

In the early 1660s, two improvements in weapons began to have a profound impact on tactics The invention of a new lock to replace the two hundred year old match eliminated many of the musket misfires that had plagued infantrymen up to that time, and also enabled night infantry operations which had been given away by the glow of the match used to fire the weapon. A knife plugged into the musket barrel had been used for

many years by hunters in the Pyrenees to defend against wounded bears The bayonet (named after the city of Bayonne) and the lock enabled the foot soldier to add to his unit's firepower, while still able to defend against cavalry attacks These two inventions rendered the pike obsolete, and made the popular cavalry charges hazardous undertakings. Nevertheless, cavalry tactics did not change appreciably for some time after their introduction.

"No period in history produced so dramatic a development of infantry weapons as did the nineteenth century "[16] The gun of this period was the result of a series of minor improvements on many existing technologies, many of them centuries old At the beginning of the nineteenth century the standard European infantry weapon was the muzzle-loading smoothbore musket The English Brown Bess musket used in 1853 was unchanged from that used in 1704 These weapons were inaccurate, unreliable and slow to reload. In the early 1800s most efforts were aimed at improving the reliability and extending use of these weapons in adverse weather

The principle of rifling[17] has been known since the sixteenth century, and was widely used in hunting and target guns because of its greater accuracy During the War of Independence many of the American soldiers were armed with rifles, but because of its slow loading time (four times longer than muskets), the rifle was believed unsuited to the mass warfare of the nineteenth century It took the perfection of a cylindriconoidal lead bullet (named the "Minié ball" after its French inventor) to make rifles practical for military operations The minié ball was an elongated projectile with a deep hollow at the base to receive an iron plug It was small enough to slide down the bore, but was

expanded by the explosion of the powder which pushed the iron plug into the indenture and spread the base of the ball into the grooves of the rifling Only after the Napoleonic Wars, with the improvement of ammunition and the introduction of the breechloader did the rifle gain acceptance as a military weapon

The idea of loading a gun by the breech, like every other innovation in gun design, occurred repeatedly over several centuries before finally coming to fruition [18] The first effective breech loader was the Dreyse needle-gun, invented by Johann Nikolaus von Dreyse in the late 1820s It was adopted by the Prussian army in 1841-42, but did not replace all muskets until 1848 After the 1866 war between Prussian and Austria when the breechloader proved its worth, all the great European powers scrambled to acquire the new weapon "No sooner had the great powers adopted the latest breechloaders than they had to rearm again, this time with repeating rifles "[19] The earliest repeaters were the product of American inventors The Americans introduced repeating rifles into military operations in the Mexican War in 1846, but this weapon had no significant impact on tactics More extensive use was made of repeating rifles during the Civil War, due mainly to mechanical improvements (e g , the Sharps rifle in 1848 and the Spencer and Henry of 1860) Further improvements were made after the Civil War, such as invention of the metallic cartridge, which won universal acceptance for the American bolt-action principle

In 1862, Dr Richard Gatling of Chicago invented a gun consisting of ten rifled barrels revolving about a fixed axis and at his own expense demonstrated it to the Union Army The U S Army did not order the new weapons until after the Civil War, and machine guns were not introduced into Europe until the 1870s

The "American system"[20] of applying interchangeable parts to the manufacture of firearms was introduced by Eli Whitney in 1797 This system was not applied in Europe until the late 1850s, but it, along with steel, profoundly changed the munitions industry and introduced the era of arms races and mass slaughter.

The *Levée en Masse*

Up to the time of the French Revolution, most of the significant changes in military affairs were generated by, or responded to, changes in the machines used in the prosecution of war In the early 1700s, most European armies were similarly armed and equipped The change introduced in this period was not mechanical or technological but conceptual

In 1708, beset by enemies on all sides, faced with the prospect of economic ruin and given a choice of continued war against the Grand Alliance or war against his grandson on the Spanish throne, Louis XIV of France made the unprecedented move of appealing directly to his subjects "All classes responded with remarkable loyalty, and the allies now faced a conflict which foreshadowed the people's wars of the future."[21] The Comte de Guibert, writing in his *Essai general de tactique*, in 1770, said "But suppose there were to arise in Europe one vigorous nation, of method and genius and sound government a people who combined simple virtues and a national militia with a fixed plan of aggrandizement, who never lost sight of system, who knew how to make war at small expense and subsist on their victories; who were not reduced to sheathing their sword by calculations of finance We would see this people subjugating their neighbors .. as the north wind blows down the frail reed!"[22]

Guibert also wrote on tactics, developing new methods of concentration "The plan is to threaten the enemy at all other points of his position This will make him divide his forces, and we can then take advantage of the geographical conditions to reunite our own at the critical point before he can unite his "[23] This is the basis of what later came to be known as Napoleonic warfare Guibert died in 1790, not having seen any of his proposals put into practice, but they formed the basis for subsequent victories

While the *levée en masse*, instituted on August 23, 1793 by the Committee on Public Safety,[24] in response to a critical military situation in which the new French republic faced a determined coalition of England, Holland, Spain, Sardinia, Prussia and Austria, is considered revolutionary in its impact on modern warfare, it is clearly an outgrowth of thoughts and proposals that had gestated for a long time, merely requiring a crisis situation to force employment In this case not just necessity, but survival, was the mother of invention "The modern nation-in-arms, half god and half monster, had been evoked to dominate the battlefields of Europe "[25]

Engines of Change

During the period between the French Revolution and World War I, there were a number of technological and industrial innovations which had both a direct and indirect impact on military affairs Most of the inventions of this period, however, grew out of decades (and in some instances even centuries) of experimentation. Some of the innovations of the period were not to have an impact on military operations until World War II

The first powered flight, for instance, was in 1903, when the Wright brothers flew 120 feet at Kitty Hawk, North Carolina The military possibilities of flight were recognized as early as 1909, when the Italian theorist, Giulio Douhet, wrote

> "To us who have only armies and navies, it must seem strange that the sky, too, is about to become another battlefield no less important than the battlefields on land and sea But from now on we had better get accustomed to this idea and prepare ourselves for the new conflicts to come If there are any nations which can exist untouched by the sea, there are certainly none which can exist without the breath of air In the future, then, we shall have three instead of two separate and well-defined fields of battle "[26]

Despite Douhet's predictions, use of the airplane before World War II was largely confined to reconnaissance

The railroad, with its ability to move large masses of supplies and numbers of people over great distances, impacted on nations' ability to mobilize large armies In the summer of 1914, for instance, 7,000 trains transported over three million French soldiers in sixteen days In two weeks, the Germans were able to move nearly four million soldiers, and large quantities of food, arms and ammunition to the front.

Neither the railroad nor the airplane, though, had any impact on the tactics of the opposing armies of the day World War I was for the most part a *danse macabre* of masses of men slogging it out over inches of terrain day after day until one side or the other had been bled dry.

The tank, another tactical tool that had been envisioned for some time, was not employed in a significant role until near the end of the war In 1917, at Cambrai, a British tank attack intended as a diversion achieved a complete rupture of the Hindenburg line [27] Originally intended by Major General J F C Fuller (chief-of-staff of the armored corps) as a gigantic raid and withdrawal, the plan was amended by the General Staff to resemble a cavalry exploitation By the end of the first day of the attack, the British tanks had penetrated German lines to a depth of 7,000 yards, the greatest ever on the Western Front. Lacking reserves and logistical support, however, the overextended British forces had ultimately to give up most of their territorial gains The potential of the tank was then realized but, like other innovations, was not fully exploited until World War II

The Atomic Age - Mushroom Clouds and Mass Hysteria

Few new weapons were invented between the end of World War I and the onset of the second war New tactical concepts, such as the German *blitzkrieg*, were based upon refinements and improvements of existing technologies Even the mass terror bombing raids of World War II had been predicted as early as 1909 by Douhet. Bombing raids on civilian targets were conducted in World War I, but it took improvements in technology to enable raids such as Dresden and Tokyo

The atomic bomb was the only revolutionary technology introduced during World War II A result of research initiated in 1941, the bomb dropped on Hiroshima on August 6, 1945, with the power equivalent to 20,000 tons of TNT, seemed to signal a new age of warfare - a weapon so powerful that it could end a war in a single stroke

The introduction of nuclear weapons, thus, would seem to herald an RMA But, did it in fact do so? "Any citizen able to add two and two could perceive that the atomic bomb, plus jet and rocket propulsion, added up to future long-distance missiles which could conceivably conquer a strong nation in a few hours. It would be necessary to go back to the year 1249 to find a comparable turning point in the history of war. But even the introduction of gunpowder does not offer a perfect analogy, since the first firearms were little more deadly than weapons dating back to Biblical times Nor did gunpowder have a rapid evolution, considering that the TNT of a modern age is only about twice as powerful as the explosives of the Middle Ages "[28]

For a short period after the end of World War II, the United States adopted a one-weapon defense policy[29]- preparing for an atomic war to be decided in the air by intercontinental bombers and guided missiles. As a result of this emphasis, conventional forces, particularly ground forces, were allowed to deteriorate, and the Korean War caught the U S. unprepared After initial reverses, the U S regrouped and finally managed to restore the status quo ante. The helicopter, which saw limited use near the end of World War II, was used extensively to lift troops and supplies during the Korean War Air mobile warfare was further improved in another limited Asian land war - Vietnam

Despite what would seem the obvious lessons of Korea, the one-weapon defense policy did not die easily. Secretary of Defense Charles Wilson, as quoted in James M. Gavin's War and Peace in the Space Age, stated "We can't afford to fight limited wars We can only afford to fight a big one, and if there is one that is the kind it will be "[30]

Gavin disagreed with defense policy and resigned when his views could not be reconciled with those of his civilian bosses. His view was that

> "If we cannot afford to fight limited wars then we cannot afford to survive, for that is the kind of war we will be confronted with That is the only kind we can afford to fight "[31]

In 1958, in his introductory remarks in a Department of the Army pamphlet, Bibliography on Limited War, army chief-of-staff General Maxwell D Taylor also stressed the need to be prepared to fight limited wars Like Gavin before him, Taylor retired early as a protest against the one-weapon policy of the President and the Department of Defense

Taylor and Gavin were right and the policy was proven by history to be wrong Since World War II, the United States has been involved in a number of conflicts in various parts of the globe All have been, from our point of view, limited wars fought with 'conventional' weaponry

Is the Information Age really all that different?

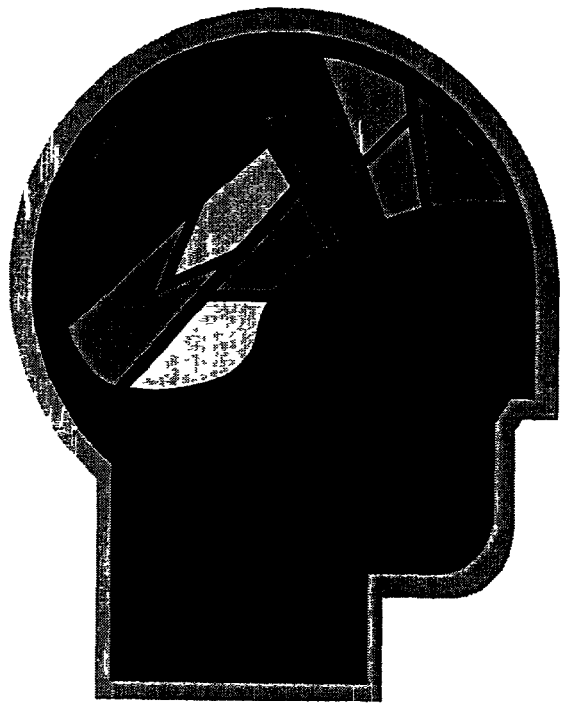
It has become commonplace to characterize our own time by its "information explosion."[32] In War and Anti-War Survival at the Dawn of the 21st Century, Alvin and Heidi Toffler state that 'The way we make war reflects the way we make wealth .'[33] The Tofflers' thesis is that war is a reflection of wealth and is subordinated to a society's prevailing mode of production. They have predicted the emergence of a Third Wave civilization based on the knowledge revolution enabled by computer-related technology, which will. in turn, spur the development of a unique war form. According to the Tofflers

a true military revolution "occurs only when a new civilization arises to challenge the old, when an entire society transforms itself, forcing its armed services to change at every level simultaneously -- from technology and culture to organization, tactics, training, doctrine and logistics When this happens, the relationship of the military to the economy and society is transformed, and the military balance of power on earth is shattered "[34]

Taking this as a starting point, we must ask if, in fact, our current age is significantly different in terms of why and how war is conducted?

The why of war does not appear to have changed since the age of armed tribes Clausewitz's definition of war as " *..an act of force to compel our enemy to do our will*"[35] remains an accurate a definition as ever The ubiquity of information does have an impact, however, on how armies fight, but this is not in itself a new phenomenon Throughout history there have been a number of "information explosions" which have had a significant impact on military operations The first was the invention of writing, which enabled the transmittal of more standardized orders and the mounting of more complicated military operations The invention of the printing press led to a further proliferation of "information" available to military commanders

Coming closer to our own age, the invention of the telegraph and the technology of submarine cables in the 1800s had a profound impact on military culture In 1870, after the British had installed submarine cables to enable communication within their far-flung empire, a few dozen messages were sent In 1895 two million messages were transmitted At first primarily for commercial use, by the late 1800s, the telegraph and submarine cable system was used increasingly for diplomatic and military purposes, including the



Despite the speed and quantity of information, our brains still process at the same speed.

construction of the Suez-Suakin line to support the British invasion of Egypt in 1882, and a direct line from Britain to the Cape of Good Hope in 1899-1901 which was used in the Boer War Cable became an essential tool of national power. "In times of crisis, they were valuable tools of diplomacy. And in times of war, the cables were security itself"[36]

Inventions and improvements in communications technology, particularly in solid state electronics, have had a profound effect on the military commander's ability to collect, process, store and transmit information related to operations In addition, the new technologies have contributed to the development of precision guided munitions (PGM) which enable destruction of targets with more accuracy and less firepower than before But does this constitute a revolution? Have we, in fact, entered the age of the Tofflerian electronic battlefield?

Taking the Tofflers' own definition of a "true military revolution" as a starting point, one has to conclude that we have not Despite the advances in information technology, large portions of the globe are still essentially First Wave (agricultural) Despite the huge lead the United States enjoys in Third Wave (knowledge) technology, organizationally and doctrinally we are still largely a Second Wave (Industrial) society in transition. What impact has this had on military organization, particularly with the end of the Cold War and the lack of a clearly identifiable opponent? A serious look at the recent past would indicate that, while information-age technologies have influenced military operations, the impact has probably not been as revolutionary as the proponents of the RMA would have us believe

"Reservations aside, the American military, especially the Army and the Air Force, are embracing the RMA As the services move into the Tofflerian Third Wave as Information Age militaries, they are preparing to fight other Information Age, Third Wave armed forces."[37] While a certain level of preparedness for fighting enemies of comparable capability is prudent, since World War II, U S military failures have come at the hands of opponents lacking our level of technology (Korea, Vietnam, Lebanon and Somalia). Relatively unsophisticated forces, when they have been dedicated and willing to sustain high casualty rates, have often prevailed over technology-rich militaries (e g , the USSR in Afghanistan) It is, therefore, also prudent to retain the capability to cope with asymmetrical threats at the same time the most potent future threat is being prepared for In the words of the U S Army hierarchy in Force of Decision Capabilities for the 21st Century, "Our Armed Forces must be able to defeat an enemy armed with machetes and rifles as well as those armed with tanks, planes, and weapons of mass destruction "[38]

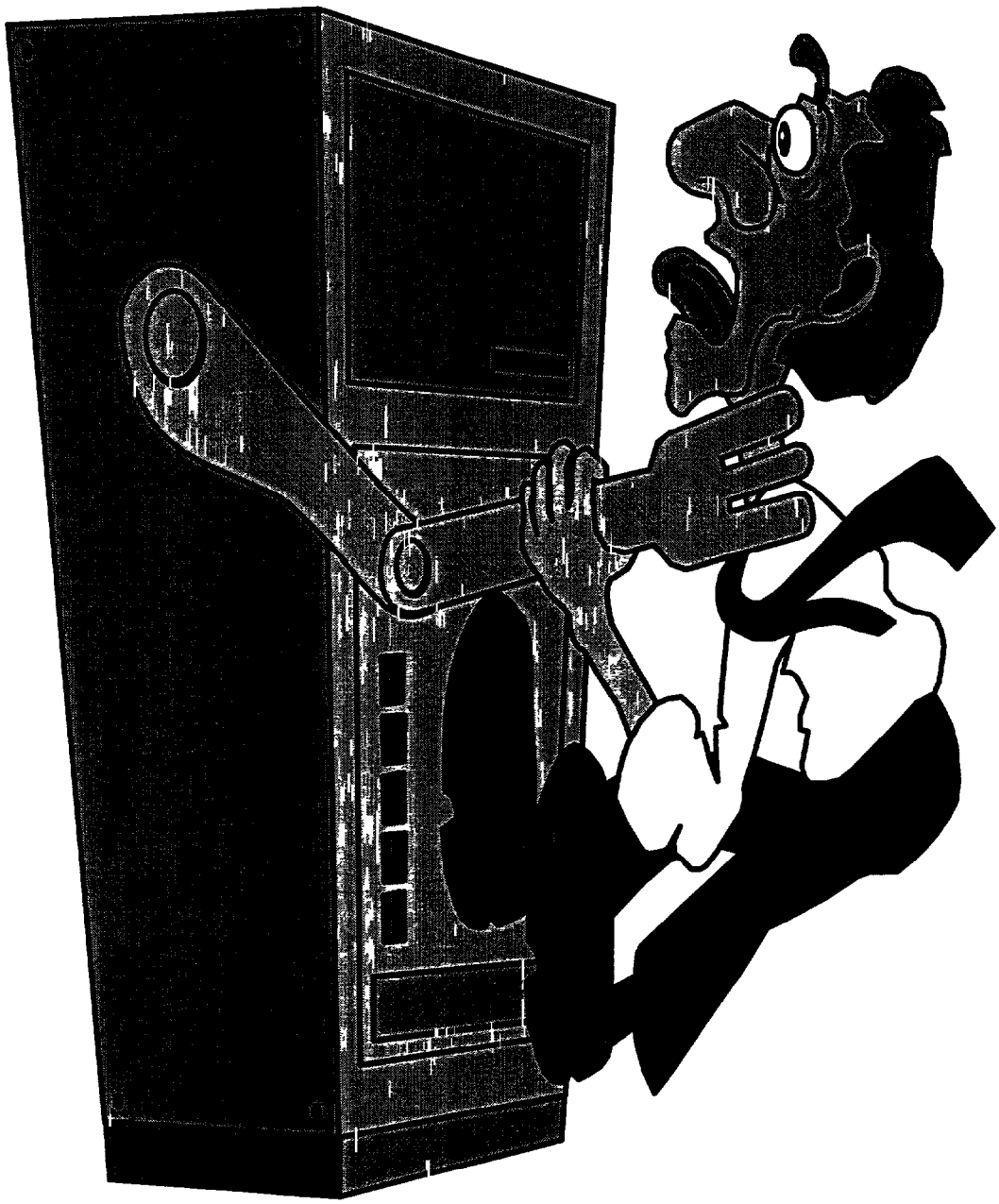
The key problem with equating information warfare (IW), or the more ambitious cyberwar, with an RMA arises from the difficulty in deciding precisely what they are According to Martin C Libicki, "coming to grips with information warfare, however, is like the effort of the blind men to discover the nature of the elephant "[39] Cyberwar, according to John Arquilla and David Ronfeldt in a Rand paper, *Cyberwar is Coming!*, refers to "conducting, and preparing to conduct, military operations according to information-related principles It means disrupting if not destroying the information and communications systems, broadly defined to include even military culture, on which an adversary relies in order to *know* itself who it is, where it is, what it can do when, why it

is fighting, which threats to counter first, etc It means using knowledge so that less capital and labor may have to be expended "[40]

Joint Publication 3-13 1[41] defines IW as "actions taken to achieve information superiority by affecting adversary information, information-based processes, information systems, and computer-based networks while defending one's own information, information-based processes, information systems, and computer-based networks The use of the word warfare in the term IW should not be construed as limiting IW to a military conflict, declared or otherwise " Each of the military services views IW through its own unique cultural and corporate perspective [42]

So, one might ask, what is new about IW that portends a revolution? While new technological developments do exist (improved computer-based systems, PGMs, etc), with the exception of some of the more esoteric *proposed* forms of warfare (e g , hacker warfare, virtual war in cyberspace), most of what is now done has been around for some time For example, anti-radar electronic warfare (EW) has been around since the invention of radar in World War II, and various forms of psychological warfare and deception operations date from antiquity Differences exist in the technical systems available for conduct of these operations

The new information technologies make available to the military commander information in greater quantity and quality, enable stand-off engagement of targets, and allow massing of weapons effects rather than forces They do not, however, make it possible for the human brain to process information any faster, nor make qualitatively better decisions Despite the greater transparency of the battlefield, the new systems have



We must master technology, or ...

not brought about any radical changes in organization or doctrine, nor do they provide one of the most important elements needed by the commander or strategist - improved knowledge of an adversary's intentions

In order to be considered truly revolutionary, the new technologies must be accompanied by radical changes in doctrine and organization It is clear that such radical changes have not taken place, but one must ask if such change is feasible or desirable

The United States has an unquestionable lead in the innovation and application of information technology, but the U S is not yet a totally information society We still depend in a large measure on industrial-age systems Further, large portions of the globe are still in the agricultural, industrial and agro-industrial stages of development - and include many likely adversaries Should the U S. military then convert to an information-based organizational and doctrinal structure? It would be safe to answer "yes" only if we could be sure that such a structure could prevail over any likely future adversary, and, in the world of today (and the foreseeable future) we cannot do so As shown in Vietnam, Lebanon and Somalia, despite our lead in technology, we can fail

Arguing against an RMA is not, however, a case against developing the new technologies to the fullest While we must maintain the capability to deal with less technologically-advanced adversaries who might develop strategies to reduce or even eliminate our advantage,[43] it would be dangerous to assume that it is impossible that some nation other than the United States will make the next dramatic leap in technology which could produce an adversary with equal or greater advantage.

Prudence dictates, therefore, that we keep a foot in both camps If we cling blindly to the past we could find ourselves unprepared to meet the challenge of a future peer competitor in the high-tech arena Excessive focus on the revolutionary aspects of military technology, however, could leave us vulnerable to a low-tech adversary Failure to find a balance between these two extremes, especially in an era of declining resources and 'right-sizing' of the military establishment, will mean wasted resources and lost opportunities No matter how fast technology changes, as long as we live in a world where the benefits of technology are not equitably distributed, we will have to maintain current capabilities in order to cope with existing dangers, while at the same time, preparing to meet as yet unknown future threats

"History alone will judge what it means to have a revolution in military affairs The uncertainties that have always surrounded warfare have a profound effect on the military profession, inclining it to conservatism, setting evolution as the normal upper limit of the rate of change "[44]

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17 Singer, Abe and Scott Rowell *Information Warfare An Old Operational Concept With New Implications.* Washington, DC National Defense University, Institute for National Strategic Studies, Strategic Forum, 1996 Number 99

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19 U S Air Force *Cornerstones of Information Warfare* Washington, DC, undated

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Notes

[1] Earl H Tilford, Jr , *The Revolution in Military Affairs Prospects and Cautions* (Carlisle Barracks, PA U S Army War College, 1995), 1
[2] Ibid, 2 "Furthermore, the weapons used by the armies of 1815 were basically the same as those available in 1789 or, for that matter, in 1715 "
[3] The concept was proposed by Comte de Guibert in 1770 in his *Essai general de tactique* Guibert died in 1790 before seeing any of his proposals translated into reality
[4] Paul Bracken and Raoul Henri Alcala, *Whither the RMA Two perspectives on Tomorrow's Army* (Carlisle Barracks, PA Army War College, 1994), 3
[5] Lynn Montross, *War Through the Ages* (New York Harper & Row, 3d edition, 1960) chapter one "Such was the dearth of public spirit that Demosthenes could not overcome the factionalism of his countrymen even when Macedonian invasion threatened," (page 14)
[6] Ibid, 18-27
[7] Ibid, 19
[8] The ballista, forerunner of the artillery fieldpiece operated by tension The catapult operated by torsion
[9] The *pilum* was a seven foot long throwing and thrusting spear which was capable of piercing most armor of the time The *gladius* was a 20-inch cut and thrust sword with a broad, sharp blade that could remove an opponents arm or leg with one well-placed swing
[10] Montross, *War Through the* Ages, 93
[11] Ibid , 95
[12] Ibid, 169
[13] Ibid, 177
[14] Ibid, 182
[15] Ibid, 181-182
[16] Daniel R Headrick, *The Tools of Empire Technology and European Imperialism in the Nineteenth Century* (Oxford Oxford University Press, 1981), 84
[17] Carving spiraling groves inside the barrel to make the bullet spin on an axis parallel to the gun barrel rather than tumbling randomly
[18] Headrick, *The Tools of Empire*, 96
[19] Ibid, 98
[20] Ibid, 99
[21] Montross, *War Through the Ages*, 364
[22] Ibid, 447
[23] Ibid, 448
[24] The decree, announcing universal conscription, read "The young men shall fight, the married men shall forge weapons and transport supplies, the women will make tents and serve in the hospitals, the children will make up old linen into lint, the old men will have themselves carried into the public squares to rouse the courage of the fighting men, and to preach hatred of kings and the unity of the Republic The public buildings shall be turned into barracks, the public squares into munitions factories, the earthen floors of cellars shall be treated with lye to extract saltpeter All suitable firearms shall be turned over to the troops, the interior will be policed with fowling pieces and with cold steel All saddle horses shall be seized for cavalry, all draft horses not employed in cultivation will draw the artillery and supply wagons "
[25] Montross, *War Through the Ages*, 452
[26] Ibid 691
[27] Ibid, 738
[28] Ibid, 965
[29] Ibid, 974 - 975
[30] Ibid, 996
[31] Ibid
[32] Headrick, *The Tools of Empire*, 157

[33] Alvin and Heidi Toffler, *War and Anti-War Survival at the Dawn of the 21st Century* (Boston, MA Little, Brown & Co , 1993), 3
[34] Ibid, 32
[35] Carl Von Clausewitz, *On War*, Edited and Translated by Michael Howard and Peter Paret (Princeton, NJ Princeton University Press, 1976), 75
[36] Headrick, *The Tools of Empire*, 163-64
[37] Tilford, *The Revolution in Military Affairs*, 14
[38] Department of the Army, *Force of Decision Capabilities for the 21st Century* (Washington, DC Department of the Army, April 15, 1996), 16
[39] Martin C Libicki, *What is Information Warfare?* (Washington, DC National Defense University, Institute for National Strategic Studies, 1995), 3
[40] John Arquilla and David Ronfeldt, *Cyberwar is Coming!* (Santa Monica, CA Rand, 1992), 6
[41] JCS, *Joint Pub 3-13 1 Joint Doctrine for Command and Control Warfare (C2W)*, 7 February 1996, I-3
[42] For the Army perspective see *FM 100-6 Information Operations*, dated August 1996 An Air Force perspective is given in an undated publication, *Cornerstones of Information Warfare* Both services, while noting the defensive aspects, stress offensive IW The Navy perspective stresses defensive IW, understandable given that when naval operations are 'seen' they are vulnerable
[43] Tilford, *The Revolution in Military Affairs*, 15
[44] Bracken and Alcala, *Whither the RMA*, 42

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